GUJARAT TECHNOLOGICAL UNIVERSITY

3rd Semester Civil Engineering – PDDC

Subject Code & Name : X30604 - Advanced Fluid Mechanics

Sr. No.	Course content
1.	**Kinematics and Dynamics :** Types of fluid flow, continuity equation in three dimensions in Cartesian coordinates, velocity and acceleration, velocity potential and stream function. Types of motion Vortex flow, Euler's Equation of motion, Bernoulli's Equation from Euler's Equation.
2.	**Viscous Flow :** Flow of viscous fluid through circular pipe and two parallel plates, loss of head due to friction in viscous flow, methods of determination of coefficient of viscosity (capillary tube method, orifice type, falling sphere Resistance method, rotating cylinder method), network of pipes (Hardy-cross method)
3.	**Turbulent Flow :** Reynolds's experiments, friction loss in pipe flow, velocity distribution in turbulent flow in pipe, sheer stress in turbulent flow, Nikuradse work on artificially rough pipe, Cole brooks and white equations : Moody's diagram.
4.	**Boundary Layer Flow :** Definitions, growth, thicknesses, drag forces, laminar and turbulent boundary layer on a flat plate, and separation of boundary layer.
5.	**Dimensional and Model Analysis :** Concept of dimensions and dimensional homogeneity dimensionless parameters, methods of dimensional analysis, model analysis, types of similarities, types of forces acting on moving fluid, dimensionless numbers, model laws, classification of model.
6.	**Open Channels :** Classification of flow in channel, velocity distribution, discharge through open channel, most economical section, specific energy and specific energy curve, critical flow, standing wave flume and parshall flume, gradually varied flow, hydraulic jump and its application.

Term Work : Term work shall be based on the above mentioned course content.

Field Visit : Field visits based on course content are suggested.

Reference Books:

1. Fluid mechanics & Hydraulic Machines By Dr.R.K.Bansal
2. Fluid mechanics By Dr.D.S.Kumar
3. Fluid mechanics & Hydraulic Machines By Dr.P.N.Modi & Sheth
4. Fluid mechanics By Dr.A.K.Jain
5. Hydraulic Fluid mechanics & Fluid Machines By S.Ramamurthan
6. Engineering Fluid Mechanic By R.J.Garde & A.C.Mirajgaoker

Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER–III • EXAMINATION – SUMMER 2013

Subject Code: X30604 **Date: 17-05-2013**

Subject Name: Advanced Fluid Mechanics

Time: 02.30 pm - 05.00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Explain hydrodynamically smooth and rough pipe.	**07**
	(b)	Explain "flow net". Write its uses and limitations.	**07**
Q.2	**(a)**	Obtain equation of continuity for three dimensional flows by Cartesian co-ordinates.	**07**
	(b)	The velocity in x. y and z directions are given by u = 2x – yt, v = y – zt and w = x – 3z + t respectively. Determine the acceleration and velocity at point (1 , 1, 2) and t = 1.	**07**
		OR	
	(b)	Discuss the specific energy curve with a neat sketch.	**07**
Q.3	**(a)**	Defines the term stream function. How it differs by potential function.	**07**
	(b)	In a two dimensional incompressible flow, the fluid velocity components are given by U = x – 4y and V = -y – 4x. Show that velocity potential exists and determine its form. Find also the stream function.	**07**
		OR	
Q.3	**(a)**	Obtain equation of continuity for the fluid flow in polar co- ordinate.	**07**
	(b)	In a two dimensional flow of compressible fluid, the tangential component of velocity $V\alpha=\frac{C\sin\alpha}{r^2}$, where C is constant. Using equation of continuity, determine the expression for radial velocity V. Also find the magnitude and direction of resultant velocity.	**07**
Q.4	**(a)**	Explain Hardy cross method.	**07**
	(b)	Describe various types of hydraulic models.	**07**
		OR	
Q.4	**(a)**	Describe Rayleigh method for dimensional analysis.	**07**
	(b)	Explain and prove Buckingham's π – theorem.	**07**
Q.5	**(a)**	Explain the concept of boundary layer. Derive the expression for displacement thickness.	**07**
	(b)	Describe Reynold's experiment and discuss the laminar and turbulent flow in pipe.	**07**
		OR	
Q.5	**(a)**	Explain formation of boundary layer with neat sketch and also explain separation of boundary layer.	**07**
	(b)	Explain Prandtle's mixing length theory.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC SEM-III Examination May 2012

Subject code: X30604

Subject Name: Advanced Fluid Mechanics

Date: 17/05/2012 **Time: 10.30 am – 01.00 pm**

Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Derive an expression for most economical section for a rectangular shaped open channel section.	**07**
	(b)	Explain and Prove Buckingham's π – Theorem.	**07**
Q.2	**(a)**	Derive an expression for gradually varied flow and state the assumptions made in it.	**07**
	(b)	Derive an expression for the velocity distribution for viscous flow through circular pipe. Also sketch the velocity distribution and shear stress distribution across a section of the pipe.	**07**
		OR	
	(b)	Explain Hardy Cross method of analysis of flow in pipe net works.	**07**
Q.3	**(a)**	(i) Derive and explain Euler's Equation of motion.	**04**
		(ii) Find the velocity and rate of flow of water through a rectangular channel of 6m wide and 3m deep, when it is running full. Bed slope 1 in 2000.Take C=55.	**03**
	(b)	Explain Prandtle's mixing length theory.	**07**
		OR	
Q.3	**(a)**	If the velocity distribution in boundary layer is given by u/U= y/δ, determine the displacement thickness, momentum thickness and energy thickness.	**07**
	(b)	Determine the maximum discharge of water through a circular channel of diameter 1.5m. When the bed slope of channel is 1 in 1100. Take C=60.	**07**
Q.4	**(a)**	Describe the Rayleish method for dimensional analysis.	**07**
	(b)	Define "Dimensional Homogeneity" and test whether following equations are dimensionally homogeneous or not. (i) $v = \frac{1}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$ (ii) $h_f = \frac{flv^2}{2gD}$ (iii) $Q = 3.33LH^{\frac{3}{2}}$	**07**
		OR	
Q.4	**(a)**	Derive the relation for laminar flow between two parallel plates the mean velocity is equal to two-third of the maximum velocity.	**07**
Q.4	**(b)**	Describe Reynold's experiment and discuss the laminar and turbulent flow in pipe.	**07**
Q.5	**(a)**	Obtain an equation of continuity for three dimensional flow.	**07**
	(b)	Explain formation of boundary layer with sketch and also explain separation of boundary layer.	**07**
		OR	
Q.5	**(a)**	Discuss the classification of channel slopes.	**07**
	(b)	Discuss the specific energy curve with a neat sketch.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC SEM-III Examination-December-2011

Subject code: X30604 **Date: 20/12/2011**

Subject Name: Advanced Fluid Mechanics **Time: 2.30 pm -5.00 pm**

Total marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Define (i) steady flow (ii) uniform flow (iii) laminar flow (iv) sub critical flow (v) two dimensional flow (vi) rotational flow (vii) comprisable flow	**07**
	(b)	Explain Hydrodynamically smooth and rough pipe.	**07**
Q.2	**(a)**	Explain 'flow net'. Write its uses and limitations.	**07**
	(b)	Shear stress at a point 40mm from axis of a pipe is 28 pa. Find wall shear stress and rate of flow if pipe diameter is 36cm and viscosity of flowing liquid is 40poise. Assume laminar flow through pipe.	**07**
		OR	
	(b)	Obtain an equation of continuity for three dimensional flow.	**07**
Q.3	**(a)**	Expiain formation of boundary layer with sketch.	**07**
	(b)	A thin plate is moving in still atmospheric air at a velocity of 5m/s. The length of the plate is 0.6 m and width 0.5 m. Calculate (i) the thickness of the boundary layer at the end of the plate, and (ii) drag force on one side of the plate. Take density of air as 1.24 kg/m3 and kinematic viscosity 0.15 stokes.	**07**
		OR	
Q.3	**(a)**	Explain Hardy cross method.	**07**
	(b)	A pipe line carrying oil s = 0.8 has average height of irregularities projecting from the surface of the boundary of the pipe as 0.3 mm. What type of boundary is it? The shear stress developed is 3N/m2. Take kinematic viscosity $\nu = 0.012$ stoke.	**07**
Q.4	**(a)**	Explain Buckingham π theorem method.	**07**
	(b)	Water is flowing through a pipe of diameter 30cm at a velocity of 4m/s. Find the velocity of oil flowing in another pipe of diameter 10 cm. if the condition of dynamic similarity is satisfied between the two pipes. The viscosity of water and oil is given as 0.01 poise and 0.025 poise. The sp. gr. of oil = 0.8.	**07**
		OR	
Q.4	**(a)**	Describe Reynolds's experiments.	**07**
	(b)	Derive an expression for the velocity distribution for viscous flow through a circular pipe. Also sketch the velocity distribution and shear stress distribution across a section of the pipe.	**07**
Q.5	**(a)**	Derive an Equation of Gradually varied flow, and write assumption made in it.	**07**
	(b)	A triangular channel having a vertex angle 1200 , calculate critical depth if flow through the channel is 15 m^3 /s.	**07**
		OR	
Q.5	**(a)**	Discus the specific energy curve with a neat sketch	**07**
	(b)	Find the slope of the free water surface in a rectangular channel of width 20m, having depth of flow 5m. The discharge through the channel is 50 m^3 /s . The bed of the channel is having a slope of 1 in 4000. Take the value of Chezy's constant C = 60.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

P.D.D.C Sem-III Examination May 2011

Subject code: X30604 **Subject Name: Advanced Fluid Mechanics**

Date:27/05/2011 **Time: 10.30 am – 01.00 pm**

Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Develop from the first principal the continuity equation in Cartesian coordinate for three dimensional flows. **07**

(b) Derive an expression for most economical section for a rectangular section. **07**

Q.2 **(a)** Derive an expression for gradually varied flow and state the assumptions made in it. **07**

(b) Discuss the specific energy curve with a neat sketch. **07**

OR

(b) Define the term stream function. How it differs by potential function **07**

Q.3 **(a)** Describe Rayleigh method for dimensional analysis. **07**

(b) Define "Dimensional Homogeneity" and test whether following equations are dimensionally homogeneous or not. **07**

(i) $Q = 3.33LH^{\frac{3}{2}}$ (ii) $h_f = \dfrac{flv^2}{2gD}$ (iii) $V = \dfrac{1}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$

OR

Q.3 **(a)** Describe various types of hydraulic models. **07**

(b) Explain and prove Buckingham's π-Theorem. **07**

Q.4 **(a)** Derive the relation for laminar flow between two parallel plates the mean velocity is equal to two-third of the maximum velocity. **07**

(b) Obtain an expression for the velocity distribution for turbulent flow in smooth pipe. **07**

OR

Q.4 **(a)** Explain the concept of boundary layer. Derive the expression for displacement thickness. **07**

(b) Derive an expression for velocity for the laminar flow through circular pipe. **07**

Q.5 **(a)** (i) Explain Hardy Cross method of analysis of flow in pipe net works. **04**

(ii Explain critical, sub critical and super critical flow in an open channel. **03**

(b) (i) Derive & Explain Euler's Equation of motion. **04**

(ii)Find the velocity & rate of flow of water through a rectangular channel of 6m wide & 3m deep, when it is running full. Bed slope 1 in2000, C=55 **03**

OR

Q.5 **(a)** (i)If the velocity distribution in the boundary layer is given by $u/U = y/\delta$ determine the displacement thickness, momentum thickness and energy thickness. **04**

(ii) The velocity in x, y and z directions are given by u= 2x-yt, v= y-zt and w= x-3z+t respectively. Determine the acceleration and velocity at point (1, 1, 2) and t=1. **03**

(b) Determine the maximum discharge of water through a circular channel of diameter 1.5m. When the bed slope of channel is 1 in 1100. Take C=60. **07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

P.D.D.C. Sem- III Examination December 2010

Subject code: X30604

Subject Name: Advance Fluid Mechanics

Date: 16 /12 /2010 **Time: 10.30 am – 01.00 pm**

Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Explain Buckingham π theorem method	**07**
	(b)	Derive the expression for the velocity distribution for viscous flow through circular pipe. Also sketch the velocity distribution and shear stress distribution across a section of the pipe.	**07**
Q.2	**(a)**	Obtain an equation of continuity for three dimensional flow.	**07**
	(b)	Derive an Equation of Gradually varied flow, and write assumption made in it.	**07**
		OR	
	(b)	Explain separation of boundary layer.	**07**
Q.3	**(a)**	Expiain formation of boundary layer with sketch.	**07**
	(b)	In a two dimensional fluid flow the component of the velocity along the x-axis is given $U = 3x-2x^2y+y^3$. Determine the component of the velocity along the y-axis for the Condition of continuity of flow.	**07**
		OR	
Q.3	**(a)**	Explain Hydrodynamically smooth and rough pipe.	**07**
	(b)	Determine the length of back water curve caused by an afflux of 1.5 m in a rectangular channel at width 45 m and depth 2.0 m. The slope of the bed is given as 1 in 2000. Take meaning's N = 0.03.	**07**
Q.4	**(a)**	Discuss the classification of channel slopes	**07**
	(b)	Laminar flow of an oil with maximum velocity at 5.6 m/sec in a 30 cm diameter pipe. If dynamic viscosity of an oil is 0.18 kg sec/m. Calculate shear stress at pipe wall and within fluid 6.0 cm from the pipe wall.	**07**
		OR	
Q.4	**(a)**	Explain Hardy cross method	**07**
	(b)	A model of spillway is made to test the flow. The discharge and velocity of flow over the model were measured as 2.5 m /sec and 1.5 m/s. Find the discharge and velocity over prototype which is 50 times larger them it's model.	**07**
Q.5	**(a)**	Discus the specific energy curve with a neat sketch	**07**
	(b)	In a two dimensional incompressible flow, the fluid velocity components are given by $U = x - 4y$ and $V = -y - 4x$ .Show that velocity potential exists and determine its form. Find also the stream function.	**07**
		OR	
Q.5	**(a)**	Explain Prandtle's mixing length theory	**07**
	(b)	Find the expression for the drag force on smooth sphere of diameter D, moving with a uniform velocity V in a fluid of density ρ and dynamic viscosity μ	**07**

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